Metrics and Guidelines to Support Effective Collaboration

Presented to

Collaboration and Knowledge Management Workshop

Team Members

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January 15, 2003

* Phase 2 SBIR from Office of Naval Research

Topics

- Definitions
- Goals
- Approach
- Theory
- Products
  - Diagnosis and recommendation tool
  - Evaluation handbook
- Tool demonstration
- Validation
- Transitions

Collaboration Definitions

- Cognitive focus
  - The mental aspects of joint problem solving for the purpose of achieving a shared understanding, making a decision, or creating a product
- Expert leverage focus
  - Experts integrating perspectives to better interpret the situation and problem, identify candidate actions, formulate evaluation criteria, and decide what to do

Goals

- Synthesize a theory of how collaboration works
- Develop theory-based metrics for evaluating collaboration effectiveness and diagnosing problems
- Apply theory to create practical products for collaboration practitioners
  - Guidelines and software for diagnosing and fixing collaboration problems
  - Guidelines for selecting collaboration tools
  - A handbook for collecting and analyzing collaboration assessment data
  - A book to improve collaboration
- Validate and transition products

Approach

- Draw on research in collaboration, teamwork, decision making, artificial intelligence, and command and control to synthesize theory
- Use theory and C2 evaluation methods to identify collaboration metrics
- Use theory and medical analogy (risks, symptoms, diagnoses, treatments) to organize guidelines
- Use “value-driven” expert system methods to capture guidelines in software
- Validate guidelines through literature references, expert consensus, and formal experiments

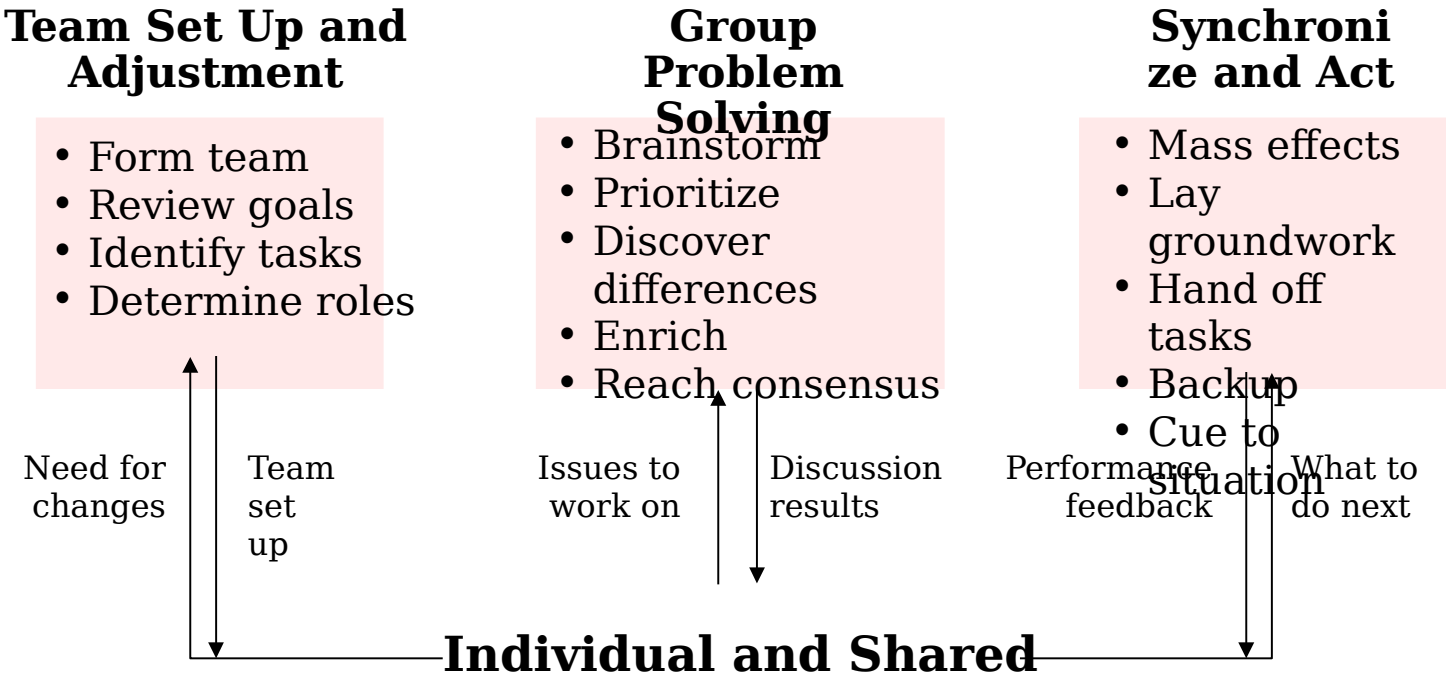
Theory

- Basic premises
- Collaboration building blocks
- The twelve enablers

Premises
Knowledge Basis for Collaboration

- Knowledge is central to collaboration and teamwork
  - Teams whose members know what they need to know can work together effectively. Those that do not are prone to various kinds of predictable errors, with the type of error dependent on the type of knowledge deficiency
- Knowledge must be distributed among members of a team
  - Everybody does not need to know everything for a team to be effective. But every team member does need to know how to get the knowledge he or she needs.
- Individuals need to know about both “taskwork” and teamwork
  - Taskwork knowledge is what team members need to carry out their tasks alone
  - Teamwork knowledge is what team members need to know to work together effectively
- The collaborative dialog helps generate the needed teamwork and taskwork knowledge
  - Team members exchange ideas to put in place the knowledge and understandings that team members must have for the team to achieve its mission.

Theory: How Teams Work
Building Blocks of Collaboration and Teamwork



Group Problem Solving
Sharing of Perspectives

- Collaboration enables teams to “make better lists”
  - Better views on what is happening, the reasons for these occurrences, and their impacts on the team mission
  - Better set of candidate actions to take in response to these impacts
  - Better set of criteria to consider when evaluating the desirability of these actions
  - Better estimates of possible consequences of the alternatives being considered

Synchronize and Act

Determine Task Adjustments (consulting with others)

- Determine if adjustments are needed
- Consider coordination and synchronization requirements. Balance individual tasks against need to support others on team
- Identify/update needed resources and information, and determine how to obtain

If team discussion on adjustments needed

Specified adjustment

Individual Actions to Carry Out the Task

Monitor/gather information

Review team and own task status in relation to team plans and goals

Identify adjustments to make on own, or identify need to discuss adjustments with others

Make adjustments as needed and continue

The Twelve Enablers

- Represents basic cognitive foundations for effective collaboration
- At a level useful for diagnosis and recommendations
  - Deficiencies in enablers are the underlying causes of teamwork problems
  - Risks and symptoms map easily to enablers
  - Recommendations follow directly from them
- Generalizes well known critical C2 and decision functions for teams

The Twelve Collaboration Enablers

TEAM PREPARATION

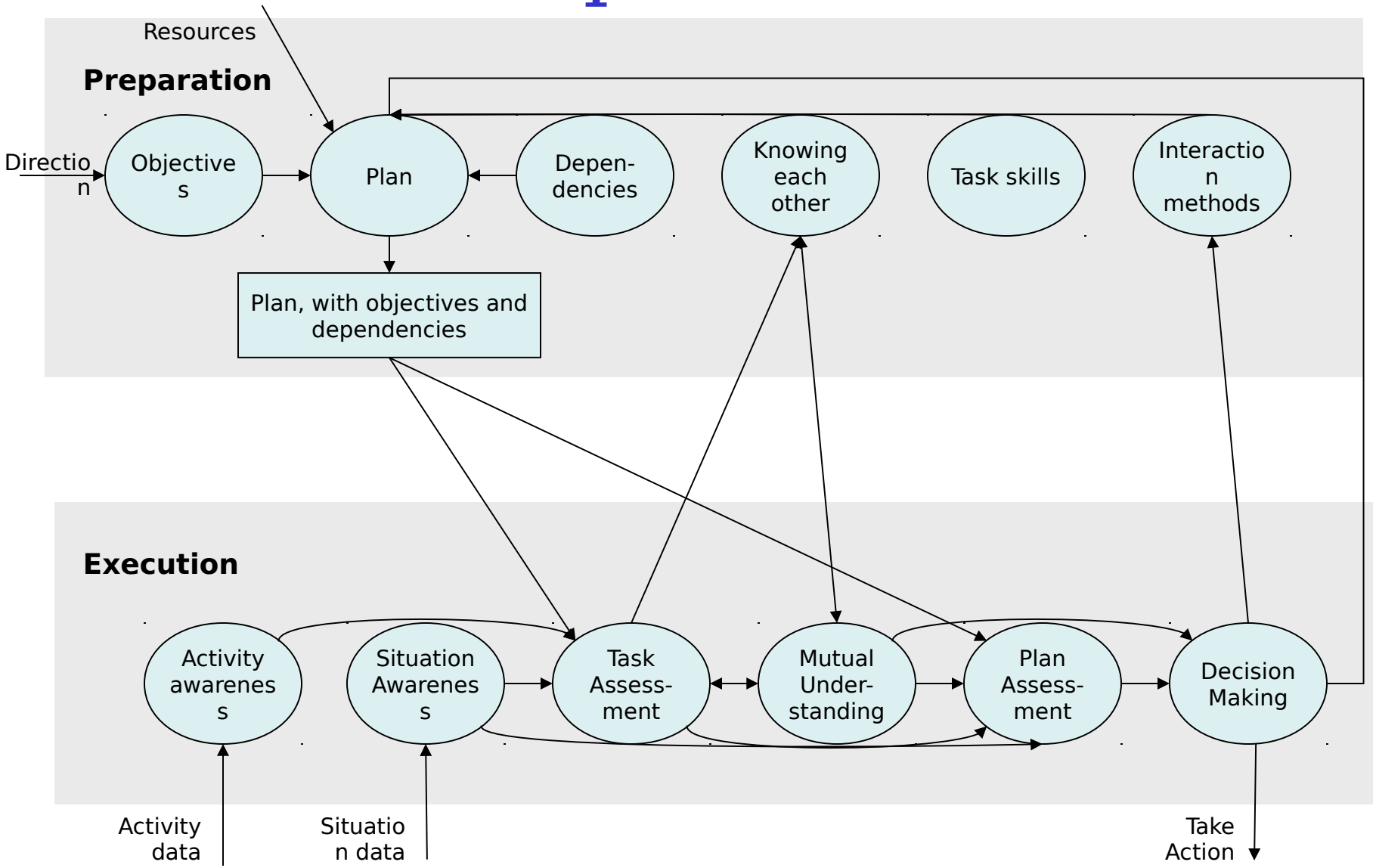
1. Understanding of goals
2. Understanding of roles, tasks, and schedule
3. Understanding of dependencies: between tasks, resources, information, and situation
4. Understanding of team members' backgrounds and capabilities
5. Understanding of methods for team member interactions
6. Adequacy of domain knowledge needed for individuals and the team to perform its tasks

The Twelve Collaboration Enablers (cont)

EXECUTION

7. Activity awareness: knowing and assessing what others are doing
8. Assessing external status: knowing what's happening in the environment
9. Task assessment: assessing task progress
10. Mutual awareness of team member understandings: knowing what others think
11. Assessing plan progress and prospects; determining if plan will still work
12. Making decisions: deciding what to do next

Principal Enabler Dependencies



Enabler Documentation

- Knowledge required to support enabler
- Consequences of deficiency
- Methods to obtain
- Factors that put enabler at risk
- Factors that make enabler especially important
- Ways to estimate state of enabler
  - Questions to ask
  - Observations to make

Product 1

Software for Identifying and Fixing Collaboration Problems

- Intended to support “true” teams whose members interact to leverage one another
- Identifies those enablers whose deficiencies of are responsible for such collaboration problems as
  - Tasks done late
  - Tasks omitted or performed when not needed
  - Poor product quality
  - Inability to react to changes
  - Poor team backup
  - Poor sharing of information
- Suggests remedies to the problems
  - Team processes
  - Collaboration Tools

Software Mechanisms

- Asks questions about the team, task, and environment
- Evaluates enablers that matter and are at risk or deficient
  - Assesses risks and symptoms of deficient enablers
  - Uses “value driven” expert system algorithms to perform diagnosis
- Finds simplest set of remedies able to address full range of issues

Examples of Risks and Symptoms

Risks to Clear Understanding of Roles, Tasks, and Schedule

1. The plan is complicated and has many tasks
2. The team never clearly defined member roles and responsibilities
3. A work breakdown structure was never developed
4. Backup responsibilities are not assigned
5. The team has more than ten members
6. No graphs and diagrams depict the schedule

Symptoms of Poor Understanding of Roles, Tasks, and Schedule

1. Team members disagree about who is responsible for various kinds of work
2. No one performs a planned tasks even though task is still needed and is feasible
3. Two or more people do a task redundantly
4. Team member asked for help say that he is not the right person to ask
5. Tasks are started or completed too late to be useful

Example* of Process Remedies

- **Articulate the team mission, goals, and importance**
  - Articulate the team goals and importance, identify consumer requirements and expectations, and quantify constraints
  - Define desired team results (products, recommendations…) and determine how to measure achievement of goals
- **Develop a plan and identify an organization to achieve goals**
  - Define tasks and schedule, determine required resources (including collaboration tools and infrastructure) and determine how to monitor and manage progress toward achieving goals
  - Define the organization (team) able to accomplish the goals. Determine expertise and skills needed, establish job roles and responsibilities that allocate expertise within team, and identify (potential) team members with needed skills
  - Establish how team will work together to leverage complementary skills.

*[Katzenbach, 1993] Katzenbach, J.R. and Smith D.K. The Discipline of Teams. Harvard Business Review, 71 (2):

Tool Remedies

General Categories of Tools

I Communications tools to enable information exchange

II Document management to organize documents

III Application sharing for joint product creation

IV Project management to review and track progress

V Situation assessment aids

VI Team support aids: people profiling and calendar support

VII Decision and task support

Services Available in Document Management Tools

a. Help team members input information to support team understanding

b. Structure, index, and catalog user input

c. Track and compare comments

d. Subscription list management

e. Discussion threat management

Demonstration of System

Product 2
Evaluators Handbook

- Explains how to collect and analyze collaboration assessment data
- Assesses four “levels” of collaboration
  - Collaboration product
  - Synchronization and coordination
  - Status of twelve fundamental collaboration enablers
  - Factors impacting enablers

Collaboration Product

- Bottom line “proof of the pudding” metrics
- Metrics for a particular product are the same, whether produced by an individual or a team
- Examples
  - Product timeliness
    - Timeliness of product production--product completion time relative to deadline
  - Product quality metrics (plan example)
    - Useful life of plan compared to its intended useful life. No plan “survives contact with the enemy,” but better plans last as long as intended
    - Fraction of commander’s objectives that plan addresses
    - Fraction of plausible contingencies covered by plan
  - Team efficiency
    - Total amount of time required to complete the product
    - Person hours to complete product

Synchronization and Coordination

- Metrics and measurement methods borrow from NCW framework
- Example metrics
  1. **Handoffs**: extent to which one person smoothly carries on with next phase of an activity previously performed by someone else (does not need to request information that was previously provided).
  2. **Laying groundwork**: extent to which one person finishes activities at the right time to support needs of another person
  3. **Situation cueing**: extent to which one person provides timely notification of important events to other team members
  4. **Synchronous massing**: extent to which team members apply mutual simultaneous force need to obtain synergy
  5. **Resource allocation/reallocation**: extent to which team members preserve critical resources needed by others
  6. **Parallel completion**: extent that team members do not need to wait for one piece of multiple precursor tasks to be completed before proceeding

Collaboration Enablers

- Measured from
  - Questionnaires (including accomplices)
  - From observed behaviors
  - From collaboration infrastructure
- Data collectors provided with a specific list of significant behaviors or conversations to note
- Cognitive and infrastructure data provides insight for causes of collaboration effectiveness

Data Collection: Questions to Ask and Observations to Make Task Assessment

Knowledge

1. What tasks are currently underway?
2. Who's working on task x?
3. How much of the task is completed?
4. What work remains?
5. Is it having any problems?
6. If so, what are the signs of problems? (need to apply progress metrics)
7. Is the work being done consistent with the plan? Is it the right thing to be done?
8. It the right amount of effort being applied?
9. Does the task need additional help
10. What resources and information does it need, and are these available?...

Behaviors

1. People are not informed when they are is doing something contrary to the plan
2. People carry out actions that are no longer needed
3. Team members don't critique or enrich team products at appropriate progress points
4. Team members do not finish activities at the right time or right manner to support needs of another person
5. People fail to provide timely notification of important events to other team members
6. Team members consume or reserve critical resources needed by others

Infrastructure

1. Availability of progress metrics
2. Ability to observe product as its being developed
3. Availability of reports on product status
4. Availability of communications to discuss product status
5. Availability of plan and schedule information

Observables for Data Collection

What Data Collectors Should Note

PARTICIPANT DISCUSSIONS

Discussions about what achievements constitute success
Proposed actions
Participant disagreements on any subject
Conversations related to resolving disagreements
Requests for help: what, from whom, to whom
Responses to requests for help
Approvals and decisions and their times
Requests for support
Anything repeated several times
Requests to take an action, and arguments used to support request
Responses to requests, and reasons for response
Complaints about anything
Comments about problems and opportunities
Comments about being surprised/ about something being unexpected
Comments about being confused
Comments on product quality, progress, task performance
Situation reports
Queries about what someone is doing
Requests for situation update
Comments about what some one else is doing, especially appropriateness
Product critiques or enrichments
Event notifications
Statements about prospects of plan working, reasons for prospects, and need for change
Comments on previous decisions or actions
Anything specified by HEAT

PARTICIPANT BEHAVIORS

Actions that follow discussions of what should be done
Tasks being performed, at level of actions specified in plan
Times that tasks begin and end
Information, resources, and labor offered to others
Reactions to situation cues
Resources team members use to perform their tasks
Tasks that team members are having difficulty performing
Actions taken in response to a request
Responses to pre-arranged signals or conventions
Actions that are taking a long time or need to be adjusted
Product/product component rejections
Actions that follow new information
Actions that follow communication from other team members
People who are either extremely busy or are not kept busy
Resource consumptions

Validation

- From existing literature
  - Most risks substantiated with sources
  - Some holes
- From expert validation of the tool
  - Second version of tool now complete
  - Validation using standard methods for expert system validation is planned for February and March
  - Need criteria for experts
  - Need recommendations for experts
- Formal experiments
  - Will show empirically that teams that follow the guidelines do better than teams that do not
  - Planned for March through October
  - Need suggestions for venues

Example of Literature Validation
For Understanding of Roles, Tasks, and Schedule

2. **The team never clearly defined member roles and responsibilities**

   "Highly productive teams consist of members whose roles are clearly defined yet not completely restricted from stepping outside the box…Job descriptions should be interchangeable, with individual roles drawn as a function of the skills needed to accomplish a particular project." (Herbelin, p. 70)

4. **Backup responsibilities are not assigned**

   "Most members are only aware of their own roles and don't know much about what others are doing. Without this more detailed knowledge, team members cannot assess whether the functions assigned to specific roles are being accomplished, meeting the team goal and/or cannot adjust to assist one another when the need rises." (Zsambok, Caroline, Klein, Gary, Kyne, Molly, and Klinger, David, p. 6)

5. **The team has more than ten members**

   "If there are more than ten to twelve people in your group, you may have too many people to apply the team discipline effectively." (Katzenbach and Smith, p. 89)

Help with Literature Validation

- Desire validating literature on several risk factors; e.g., wish to show following are risk factors for understanding task, information, resource, and situation dependences
  - The specification of information needed under various circumstances is unclear
  - Some tasks are extremely sensitive to the success of other tasks
  - There is a competitor or adversary that can impact the team's success
- Desire contradicting literature on any element

Transitions

- Collaboration Diagnosis and Recommendation Tool
  - In SOW for EBR War Room
  - Will integrate tool into intense collaboration environment
  - Will help people in War Room collaboration environment work together effectively
- Collaboration evaluation and evaluation metrics
  - Initial support to the KSA FNC approved
  - Support to ForceNet and DISA evaluations under discussion
- Commercial book on effective collaboration
  - Will follow publication path followed successfully for War Room
- Navy Commercialization Assistance Program
  - Selected as “finalist”
  - Will receive assistance in publicizing and marketing SBIR products

Summary

- A knowledge-centered theory can explain how collaboration works
- This theory informs collaboration performance metrics, guidelines for diagnosing collaboration problems, and methods for correcting collaboration problems
- Validation is a major component of current and planned research.
  - First phase of literature-based validation complete, but some holes need filling
  - Expert validation of software tool planned for February and March, but need criteria and suggestions for experts
  - Formal experiment validation planned on guidelines. Suggestions for venues appreciated
- Initial commitments received for transition of diagnosis/recommendation tool and for evaluation methodology